WE CLAIM:

1. A method for producing a germanium oxynitride layer on a Ge-based material, comprising the steps of:

incorporating a first concentration of nitrogen into a surface layer underneath a first surface of the Ge-based material; and

inducing growth of the oxynitride layer by exposing the first surface of the Ge-based material to an oxygen containing ambient, wherein the first concentration of nitrogen in the surface layer is controlling the growth of the oxynitride layer.

2. The method of claim 1, wherein the produced oxynitride layer has less than about 6nm of equivalent oxide thickness (EOT).

3. The method of claim 2, wherein the produced oxynitride layer has between 0.5nm and 5nm of EOT.

4. The method of claim 1, wherein the Ge-based material consists essentially of Ge.

5. The method of claim 1, wherein the step of incorporating the first concentration of nitrogen is carried out by subjecting the first surface to a nitrogen containing gas under thermal conditions.

6. The method of claim 5, wherein the nitrogen containing gas is NH_3.

7. The method of claim 6, wherein the thermal conditions are selected to be a temperature between 450°C and 700°C applied for between 1 second and 300 seconds.

8. The method of claim 1, wherein the step of incorporating the first concentration of nitrogen is carried out by ion implanting a nitrogen dose into the first surface.

9. The method of claim 8, wherein in the step of ion implanting the nitrogen dose is selected to be between about 1E15 per cm^2 and 2E16 per cm^2.

10. The method of claim 9, wherein in the step of ion implanting an implantation energy is selected to be between 0.5KeV and 10keV.

11. The method of claim 9, wherein the step of ion implanting is carried out through a screen layer.

12. The method of claim 1, wherein the step of incorporating the first concentration of nitrogen is carried out by subjecting the first surface to a nitrogen containing plasma.

13. The method of claim 12, wherein the nitrogen containing plasma is being applied with a power of between about 25W and 1000W, at a temperature of between about room temperature and 500°C, and for a time of between about 1sec and 300sec.

14. The method of claim 1, wherein the an integrated value of the first concentration of incorporated nitrogen is between about 1E14 per cm^2 and 3E15 per cm^2.

15. The method of claim 1, wherein the exposing to the oxygen containing ambient is carried out by subjecting the first surface under thermal conditions to species selected from the group consisting of O_2, O_3, H_2O, NO, N_2O, and combinations of these species thereof.

16. The method of claim 15, said thermal conditions are selected to be a temperature between 500°C and 700°C applied for between 1 minute and 30 minutes.

17. The method of claim 1, wherein the exposing to the oxygen containing ambient is carried out by subjecting the first surface to an oxygen containing plasma.

18. The method of claim 17, wherein the oxygen containing plasma is being applied with a power of between about 25W and 1000W, at a temperature of between about room temperature and 500°C, and for a time of between about 1sec and 300sec.

19. The method of claim 1, further comprising the step of cleaning the first surface before the incorporating of the first concentration of nitrogen, wherein the cleaning comprises at least one application of an oxidation and oxide removal cycle, wherein the oxidation is accomplished with an H_20_2 containing solutions, and the oxide removal is accomplished by a stripping agent, wherein the stripping agent is HF, HCl, or their mixture thereof.

20. The method of claim 1, wherein the first surface is having at least two locations, and wherein the step of incorporating the first concentration of nitrogen is carried out on the at least two locations in a manner to yield differing first concentrations of the incorporated nitrogen, whereby the produced germanium oxynitride layers on the least two locations have differing EOT.

21. A method for fabricating a high performance Ge-based field effect device, wherein the device comprising a germanium oxynitride gate dielectric, and production of the germanium oxynitride gate dielectric is comprising the steps of:

incorporating a first concentration of nitrogen into a surface layer underneath a first surface of the Ge-based material; and

inducing growth of the oxynitride layer by exposing the first surface of the Ge-based material to an oxygen containing ambient, wherein the first concentration of nitrogen in the surface layer is controlling the growth of the oxynitride layer.

22. The method for fabricating of claim 21, wherein the high performance Ge-based field effect device is a Ge MOS transistor.

23. The method for fabricating of claim 21, wherein the germanium oxynitride gate dielectric has between 0.5nm and 5nm of EOT.

24. A Ge-based field effect device, comprising:

a germanium oxynitride gate dielectric with less than 6nm of EOT.

25. The Ge-based field effect device of claim 24, wherein the germanium oxynitride gate dielectric has between 0.5nm and 5nm of EOT.

26. The Ge-based field effect device of claim 24, wherein the germanium oxynitride gate dielectric possesses greater resistance against charge tunneling than a SiO_2 gate dielectric, meanwhile a capacitance per unit area of the germanium oxynitride gate dielectric is at least as large as the capacitance per unit area of the SiO_2 gate dielectric.

27. The Ge-based field effect device of claim 24, wherein the device is a Ge MOS transistor.

28. A high performance processor, comprising:

at least one chip, wherein the chip comprises at least one Ge-based field effect device, and wherein the device comprising a germanium oxynitride gate dielectric with less than 6nm of EOT.

29. The high performance processor of claim 28, wherein the processor is a digital processor.

30. The high performance processor of claim 28, wherein the processor comprises at least one analog circuit.